

Fast Growing Cyanobacterial Strains for Biochemical Production

Kira Winsor, Chemical Engineering
Mentor: Dr. Arul Varman, Assistant Professor
School for Engineering of Matter, Transport, and Energy

Can faster growing strains of cyanobacteria be used for increased and more efficient biochemical production?

Abstract

Cyanobacteria are photoautotrophs that are used and studied for the production of sustainable biochemicals but are not typically used for large scale production because of their low growth rate compared to other cells, such as *E-coli*. Two newly discovered fast-growing strains of cyanobacteria were studied, *Synechococcus elongatus* UTEX 2973 and *Synechococcus* sp. PCC 11901, to verify their capability for production of biochemicals. Literature survey was conducted to identify optimal growth conditions for these strains along with the plasmids that could be used for biochemical production. This information can be used to test the growth rate and production of these strains.

Plasmids for Biochemical Production

Strain	Chemical	Plasmid	Reference
PCC 11901	Free Fatty Acid Production	pSW068 and pSW071	2
UTEX 2973	eFYP	pRL443 and pRL623	3
UTEX 2973	Sucrose	pSK0105	1

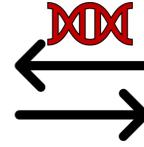
The Next Steps



Culture the strains using the optimal growth conditions.



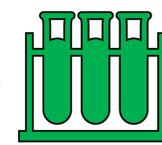
Construct the plasmids for the production of biochemicals.



Transformation of the plasmids into the cells



Test for the production of the biochemical.



Measure and verify the amount of the biochemical produced.

Optimal Growth Conditions

Strain	Temperature (°C)	% CO ₂	Light Intensity (μmoles photons* m ⁻² *s ⁻¹)	Doubling Time (hr)	Medium	Reference
UTEX 2973	41	3%	500	1.9	BG-11	3
PCC 11901	38	1%	660	2.14	AD7	2
UTEX 2973	41	1%	660	1.93	BG-11	2

Conclusion

- PCC 11901 and UTEX 2973 are both fast growing cyanobacterial strains that can be used for biochemical production.
- Even though UTEX 2973 has a faster doubling time, PCC 11901 has the capability of reaching a higher biomass and biochemical production.
- The optimal growth conditions for both strains are at high temperatures and high light intensities.

Motivation

- Cyanobacteria are photoautotrophs, which allows for sustainable reproduction with minimal nutrient input.
- It has been developed and used as a platform for biochemical production because of its sustainable reproduction.
- Compared to other organisms used for biochemical production, such as *E. coli*, cyanobacteria has a much slower doubling time.
- Newly discovered strains of cyanobacteria may be used for more efficient biochemical production due to the faster growth rate of these strains.

Future Work

- Optimal growth conditions will be used to test the growth rate of PCC 11901 and UTEX 2973.
- Plasmids identified along with others will be used to test biochemical production.

Acknowledgements

- Dr. Arul Varman
- Nima Hajinajaf

References

1. Song, K., Tan, X., Liang, Y. *et al.* The potential of *Synechococcus elongatus* UTEX 2973 for sugar feedstock production. *Appl Microbiol Biotechnol* **100**, 7865–7875 (2016). <https://doi.org/ezproxy1.lib.asu.edu/10.1007/s00253-016-7510-z>
2. Włodarczyk, A., Selão, T. T., Norling, B., and Nixon, P. J. (2020) Newly discovered *Synechococcus* sp. PCC 11901 is a robust cyanobacterial strain for high biomass production. *Communications Biology* **3**.
3. Yu, J., Liberton, M., Cliften, P. *et al.* *Synechococcus elongatus* UTEX 2973, a fast growing cyanobacterial chassis for biosynthesis using light and CO₂. *Sci Rep* **5**, 8132 (2015). <https://doi.org/10.1038/srep08132>